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(12) (19) (CA) **Demande-Application**

(21) (A1) **2,229,214**
(86) 1996/06/04
(87) 1997/02/27

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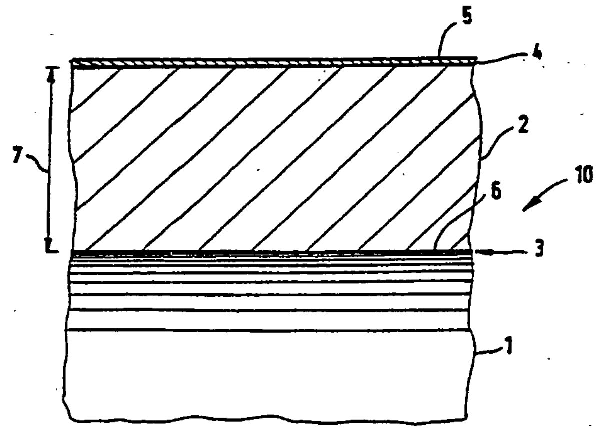
(51) Int.Cl.^{6} D21G 1/02, D06C 15/08, D06M 11/83
(30) 1995/08/11 (195 29 711.3) DE
(30) 1996/04/22 (296 07 233.8) DE

(54) **ROULEAU**
(54) **ROLLER**



(57) Un rouleau (10) pour traiter des bandes de papier, carton, plastique, textile et équivalent, comporte un corps cylindrique (1) et un revêtement (2) en alliage de plomb formant sa surface de traitement (5). Ce revêtement (2) est à son tour revêtu d'une couche (4) en matériaux durs lui conférant une résistance à l'usure.

(57) A roller (10) for treating webs of paper, cardboard, plastic, textiles and the like has a cylindrical roller body (1) and a coating (2) of a lead alloy applied to it and forming the processing surface (5) of the roller. The coating (2) is in turn coated with a layer (4) of hard materials providing wear resistance.

ABSTRACT

A roller (10) for treating webs of paper, cardboard, plastic, textiles and the like has a cylindrical roller body (1) and a coating (2) of a lead alloy applied to it and forming the processing surface (5) of the roller. The coating (2) in turn has a coating (4) of hard materials providing wear resistance. (Fig. 1)

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TRANSLATION

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ROLLER

The invention relates to a roller of the type corresponding to the preamble of Claim 1.

Such rollers are used in many different ways for treating the webs in question, particularly for glazing and satin-finishing paper. In this case, a roller with an elastically resilient coating works together with a heated counter-roller that has a smoothly polished roller circumference made of steel, as presented in DE 30 20 669 A1, for example. The elastically resilient coating can be comprised of plastic with a radial thickness of about 10 mm to 30 mm. In earlier times, in particular, the elastically resilient rollers were structured as so-called paper rollers, ring-shaped disks of paper being lined up one behind the other on the roller body, and compressed between end disks made of steel, under high axial pressure, to form a compact surface. The paper rollers are buffed, so that they have a precise cylindrical circumference surface. The paper covering has properties which are particularly advantageous for the process of glazing or satin-finishing paper. In the calender or in the glazing unit, the paper rollers are generally used alternating with hard rollers with a steel surface, which are heated if necessary. Predominantly, therefore, a soft roller and a hard roller are paired together in the roller nip of a calender or a glazing unit.

The actual glazing effect occurs on the side of the heated "hard" roller, while hardly any change in the paper is found on the side of the "soft" roller. The soft roller is used to ensure a certain resilience in the roller nip. The incoming paper web has an internal structure with thicker and harder spots. If such a paper web were to be glazed between two hard rollers, a so-called grease effect could occur in the paper, with the

harder spots being forcibly made level and therefore demonstrating a certain glassiness and, under some circumstances, even a dark discoloration. These effects come about due to overly high pressure at the denser spots of the paper, which are avoided by the interaction of a hard roller with a soft roller.

In order to achieve the necessary overall effect on the paper web, it is already known from DE 32 01 635 C2 to have two pairs of rollers act on the paper web, one immediately after the other, where the contact of the soft roller can take place from the same side of the paper web if the aim is to protect the soft coverings which are subject to the milling work, and the desired effect is to be achieved in two steps, or from different sides if the paper is to be given the desired surface improvement on both sides at the same time.

In the known devices for creating glaze and shine, the soft roller actually hardly participates at all in the desired effect, but rather only has the function of protecting the paper web. This has the result that in many cases, several roller nips are necessary in order to achieve the desired effect.

The invention is based on the task of structuring a roller of the type indicated, in such a way that it can be included to a greater extent in the treatment process of the web, particularly the paper web.

This task is accomplished by means of a roller of the type corresponding to the preamble of Claim 1.

With regard to elastic resilience, it is possible to ensure that the conditions are similar to those for a roller provided with a plastic coating, for example of harder polyurethane, by means of a suitable selection of the soft metal. In the present connection, the term "soft metal" is intended to mean metals whose modulus of elasticity amounts to several times the modulus of elasticity of the usual plastic coatings, but which still possess sufficient resilience and elastic memory to be able to exercise the function of reducing pressure stress peaks in a substrate such as paper, when used as a roller coating, if this paper is being glazed between a roller coated with "soft metal" and a hard roller.

The decisive point of the soft metal coating, however, is that a roller with a metal coating is far superior to a roller with a plastic coating with regard to heat conductivity. Such a roller can therefore influence the amount of heat transferred between the web and the roller in a completely different way than a roller provided with a plastic coating, or a paper roller.

This property is particularly effective if the roller is heated from the inside and heat is to be transferred to the web surface through the coating. This works to a much greater extent in the case of a metal coating than in the case of a plastic or paper coating.

In accordance with Claim 2, possible soft metals are those with a melting point of more than 200 °C and a modulus of elasticity of less than 80,000 N/mm^2, particularly less than 20,000 N/mm^2 (Claim 3).

The 200 °C limit is determined by the maximum surface temperatures of rollers for treating paper, plastics, and the like which occur at present. The upper limit for the modulus of elasticity ensures that the elastic resilience is still present to a sufficient degree and is comparable in its function to a coating of plastic or paper.

Important exemplary embodiments for soft metals to be used according to the invention are those such as lead and/or magnesium and/or aluminum (Claim 4). Lead has a melting point of 327 °C and a modulus of elasticity of about 17,500 N/mm^2, magnesium has a melting point of about 650 °C and a modulus of elasticity of about 29,000 N/mm^2, aluminum has a melting point of approximately 660 °C and a modulus of elasticity of about 77,000 N/mm^2.

For an optimum adjustment of the mechanical properties of the coating, pure metal will not be used in most cases, but rather a suitable lead and/or magnesium and/or aluminum alloy will be used (Claim 5).

Possible lead alloys are, for example, materials such as hard lead, diecasting alloys with a lead base, and bearing metal with a lead base.

It is also possible to use an alloy which contains lead and/or magnesium, in which lead and/or magnesium and/or aluminum are not the base material, but rather

only an additive to an alloy structured in some other way (Claim 6).

The thickness of the soft metal coating can correspond approximately to the thickness of a conventional plastic coating, and amount to 5 mm to 20 mm (Claim 7), particularly 10 mm to 15 mm (Claim 8).

For producing the lead coating on the cylindrical roller body, all suitable known methods can be used. For example, in accordance with Claim 9, the coating can be applied to the roller body in the melted, fluid state, for example by way of lead dipping, or by means of processes similar to application welding, or by spraying.

In accordance with Claim 10, however, the coating can also be applied to the roller body in the form of molded parts, which are soldered to the roller body and, if necessary, to each other.

One possibility, for example, is winding on strip-shaped extruded profile material made of the soft metal, in the manner of DE 25 45 146 A1, DE 27 22 023 A1, or DE 27 26 812 A1. However, rings which correspond to the diameter of the roller body can also be put on and soldered to the latter and to each other, at their faces. Finally, it is also possible to bend plates in accordance with the circumference of the roller body and to affix them there.

The roller provided with the coating of soft metal is subsequently turned and buffed, so that it obtains a clean, sealed cylindrical surface.

To improve the elastic properties of the soft metal, the latter can be dispersion-hardened (Claim 11).

An alternative possibility consists of using amorphously solidified soft metal, which is obtained by leaving a soft metal melt on a very cold counter-surface, for example a cooled drum, or spraying it on (*VDI-Nachrichten* (1985), Issue 22 dated May 31, 1985, page 6). The undercooled metal layers, i.e. the flat metal layers which solidified before reaching a crystalline arrangement, can be joined together to form thicker units which result in the coating.

An important further development is the subject matter of Claim 13. The porous structure results in advantageous elastic resilience for the treatment purpose,

because of the reduced bearing cross-section, in spite of the metallic material, i.e. material with good heat conductivity. The existing forces are concentrated on the material framework present between the pores, and result in higher deformations there, in accordance with the higher stresses at a specific force.

The porous structure can be produced by means of a sintering process (Claim 14). A possible embodiment is sintering together small hollow spheres of the soft metal at their outside circumference (Claim 15), which makes it possible to lower the total modulus of elasticity of the coating below the value of the compact metal. In order to make this particularly effective, small hollow spheres with a relatively low wall thickness according to Claim 16 are recommended. Aluminum is of particular significance for the small hollow spheres.

The porous structure can also be brought about by foaming up a metal melt (claim 17) (*VDI-Nachrichten* (1995), No. 37 dated September 15, 1995, page 24), which results in a metal sponge.

However, a coating of a soft metal in the form of micro-honeycombs (Claim 18) is also included in the concept of the porous structure; these can be obtained by corresponding deformation of metal foils and are known from catalyst technology. It is practical if the micro-honeycombs, which have a hexagonal cross-section, for example, stand radial to the roller with their axis.

In the porous material, the remaining cross-sections and therefore the heat conductivity are reduced as compared with a solid material. In order to balance this out, it can be recommended that the pores are at least partially filled with a heat-conductive material different from the material of the coating (Claim 19).

In most instances, the rollers in question work at elevated temperatures in the range of up to about 200 °C. They cool down to ambient temperature during the breaks in operation. In order not to have severe heat stresses occur in connection with these temperature differences, which could cause the coating to come loose from the cylindrical roller body over time, the development according to Claim 20 is recommended, where an aluminum material is suited as the carrier material for the

possible soft metals (claim 21).

The webs exert a significant wear effect on the processing surface of the roller, particularly if they consist of paper and contain mineral components. The unprotected soft metal surface would not withstand this effect for long.

It is therefore recommended that the coating in turn have a thin coating of a wear-resistant material (Claim 22), e.g. hard materials (Claim 23).

Possible hard materials are, for example, carbide materials such as tungsten carbide, chrome carbide, and titanium carbide, or oxide materials such as Al_2O_3, $AlTiO_3$, titanium oxide, chrome oxide, and the like. Processes are known to enable application of such coatings on substrates, in a thin layer, without using particularly high temperatures. Such coatings are used successfully, for example, for cutting materials.

In the massive form, the materials mentioned are very brittle. In a thin layer, however, they are very elastic and are able to follow the deformations of the soft metal underneath them without breaking or splintering. Since this elasticity depends on the thinness of the layer and the accompanying freedom of the structure from defects, a thickness of the coating layer of less than 50 My is recommended, in accordance with Claim 24, in many cases even one of less than 10 My (Claim 25).

The point of departure of the invention and its significant case of application is paper-glazing. The invention is also embodied in a glazing unit for treating paper, in accordance with Claim 26.

Here, the known "soft" roller with a plastic coating, as in DE 30 20 669 A1 and DE 32 01 635 C2, for example, is replaced with a roller with a coating of a soft metal, which allows significantly greater heat transport from the interior of the heated roller to the back of the paper web which lies opposite the heated steel roller. In this way, a treatment effect is also brought about on this back of the paper web, and the "soft" roller is included in the treatment function. In some cases, this will make it possible to avoid double arrangements of roller pairs to achieve a sufficient one-sided or double-sided effect, and to achieve sufficient glazing for some types of paper in only one roller

nip.

The treatment effect can be intensified if two rollers of the type according to the invention work against one heated steel roller (claim 27).

The drawing shows an exemplary embodiment of the invention.

Fig. 1 shows a detail of the border region of the roller, indicated in Fig. 2 with I, where the coating is cut open in a plane passing through the axis;

Fig. 2 shows a view of a roller pair, the top roller being structured according to Fig. 1.

The roller indicated as a whole with 10 in Fig. 1 comprises a cylindrical roller body 1. This roller body 1 can be a solid roller with or without internal channels for heating. However, roller body 1 can also be a hollow roller of a deflection-controlled roller, which is hydraulically supported from the inside and which can be heated from the inside by means of the hydraulic fluid which serves to support it, or by means of an additional heat carrier fluid.

Fig. 1 shows only a detail of a region of cylindrical roller body 1, close to the surface. In practice, roller body 1 can have a diameter from 500 to 1000 mm.

Roller body 1 carries a coating 2 with a uniform thickness over the entire surface, which is comprised, in the exemplary embodiment, of a lead alloy which is soldered at border surface 3 to the outer surface of cylindrical roller body 1, as indicated by heavier line 6. Soldering is only possible if coating 2 was previously present as a molded part. If coating 2 is applied in the melted, fluid state, 6 refers to the connection surface with cylindrical roller body 1.

In the exemplary embodiment shown, thickness 7 of coating 2, i.e. its radial expanse, is 12 mm.

On its outside circumference, coating 2 possesses a thin coating 4 of tungsten carbide, outside 5 of which forms the processing surface of the roller and is intended to reduce the wear effect on the soft lead alloy of coating 2. The thickness of coating 4 is shown in exaggerated manner in Fig. 1. In fact, it is only on the order of about 10 My.

Fig. 2 shows a case of use of roller 10, in the form of a two-roller glazing unit

100 with rollers 10 and 20, which together form a roller nip 8, through which a paper web 9 is passed.

Top roller 10 can be deflection-controlled and heated, and possesses a coating 2 of a lead alloy with a wear-resistant coating 4, as shown in Fig. 1. Bottom roller 20 is a roller which can be heated, with a polished circumference made of chilled cast iron.

While there was hardly any participation of the soft roller in the glazing process in the known roller pairs in glazing units, in which one roller had a coating made of plastic, because of its poor heat conductivity, coating 2, if it consists of a lead alloy, conducts the heat from the interior of heated roller 10 to the surface of the paper web practically in the same manner as is the case for hard roller 20 with the steel surface. In this way, the total amount of heat transferred to the paper web is significantly increased, on the one hand, and in particular, an effect on the back of paper web 9, which lies opposite roller 20, also takes place, resulting in increased smoothness there, also.

Claims

1. A roller for treating webs of paper, cardboard, plastic, textiles and the like, with a cylindrical roller body (1) and a coating of an elastically resilient material applied to it, which forms the processing surface (5) of the roller, characterized in that the coating (2) consists of a soft metal.

2. The roller according to Claim 1, characterized in that the soft metal has a melting point of more than 200 °C and a modulus of elasticity of less than 80,000 N/mm^2.

3. The roller according to Claim 2, characterized in that the soft metal has a modulus of elasticity of less than 20,000 N/mm^2.

4. The roller according to one of Claims 1 to 3, characterized in that the coating (2) comprises lead and/or magnesium and/or aluminum.

5. The roller according to Claim 4, characterized in that the coating (2) consists of an alloy containing lead and/or magnesium and/or aluminum.

6. The roller according to Claim 4, characterized in that the coating (2) consists of an alloy which contains lead and/or magnesium and/or aluminum.

7. The roller according to one of Claims 1 to 6, characterized in that the coating (2) has a thickness of 5 to 20 mm.

8. The roller according to Claim 7, characterized in that the coating has a thickness of 10 mm to 15 mm.

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9. The roller according to one of Claims 1 to 8, characterized in that the coating (2) is applied to the roller body (1) in the melted, fluid state.

10. The roller according to one of Claims 1 to 8, characterized in that the coating (2) is applied to the roller body (1) in the form of molded parts.

11. The roller according to one of Claims 1 to 10, characterized in that the coating (2) comprises a dispersion-hardened soft metal.

12. The roller according to one of Claims 1 to 11, characterized in that the coating (2) comprises a soft metal which is amorphously solidified.

13. The roller according to one of Claims 1 to 11, characterized in that the coating (2) has a soft metal with a porous structure.

14. The roller according to Claim 13, characterized in that the coating (2) comprises a sintered soft metal.

15. The roller according to Claim 14, characterized in that the coating (2) comprises small hollow spheres made of soft metal which are sintered together at their outside circumference.

16. The roller according to Claim 15, characterized in that the wall thickness of the small hollow spheres is at most 0.2 times their outside diameter.

17. The roller according to Claim 13, characterized in that the coating (2) comprises a metal sponge.

18. The roller according to Claim 13, characterized in that the coating (2)

comprises a soft metal in the form of micro-honeycombs.

19. The roller according to one of Claims 13 to 18, characterized in that the pores are filled with a heat-conductive material.

20. The roller according to one of Claims 1 to 19, characterized in that the cylindrical roller body (1) consists, at least on its outside circumference, of a material with a thermal expansion coefficient similar to that of the coating 82) [sic].

21. The roller according to Claim 20, characterized in that the material is an aluminum material.

22. The roller according to one of Claims 1 to 21, characterized in that the coating (2) in turn has a thin coating (4) of a wear-resistant material.

23. The roller according to Claim 22, characterized in that the coating (4) consists of hard materials.

24. The roller according to Claim 22 or 23, characterized in that the thickness of the coating is less than 50 My.

25. The roller according to Claim 24, characterized in that the thickness of the coating (4) is less than 10 My.

26. Glazing unit for treating paper, with two rollers (10, 20) which form a roller nip (8), one (20) of which can be heated and has a processing surface of the roller made of smooth steel, and the other of which is a roller (10) which can also be heated, in accordance with one of Claims 1 to 25.

27. Glazing unit for treating paper, with three rollers, the first of which can be heated and has a processing surface of the roller made of smooth steel, and the other two of which do not touch one another and are rollers which can also be heated, in accordance with one of Claims 1 to 25, each of which forms a roller nip with the first roller.

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TRANSLATION

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FIG. 1

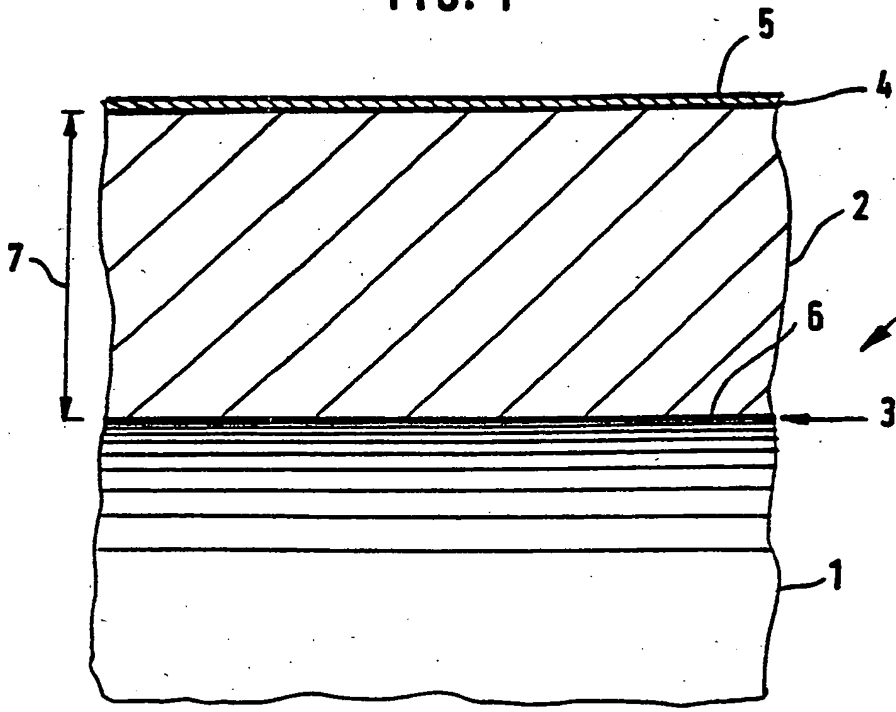

FIG. 2